

At the end of April 2019, a spectacular mineral dust episode was observed in Warsaw. The dust originated from surrounding agricultural fields and appeared relatively close to the ground in a sort of sandstorm. This phenomenon coincided with the long-range inflow of mineral dust from Sahara desert. The situation seemed so unique that it immediately aroused public and media interest. Several questions arose: Can the presence of mineral dust affect the quality of life and human health? Is it possible to measure the amount and height at which dust is observed? Is there a significant difference between the mineral desert dust brought from Africa and the local agricultural dust? Does occurrence of such dust have an effect on cloud formation? Are such events affecting climate change and contribute to hazardous weather phenomena? Note that dust intrusions are not obsolete for Poland and Central-Eastern Europe. Statistics show that such events constitute 30% (2013-2020) of different atmospheric aerosol types over the area. This is especially significant for a complex shape of dust particles affect on the radiation balance of the Atmosphere-Earth system.

Increasingly more researchers are focusing on the measurements of atmospheric aerosol, especially mineral dust is recognized as a very important component. An air quality monitoring network of the Polish Chief Inspectorate for Environmental Protection (GIOŚ) carries out measurements within surface network at a national level. Intensively developed by the European Space Agency (ESA) satellite measurements allow for observations of aerosol suspended in the atmosphere at significant altitudes above the Earth's surface. The column-integrated measurements of the AEROSOL RObotic NETwork (AERONET) provide data at 5 sites in Poland. However, these complementary infrastructures do not provide complete information on the vertical distribution of aerosol.

The vertical structure is delivered by unique lidar measurements conducted at the Remote Sensing Laboratory (RS-Lab) at the Faculty of Physics of the University of Warsaw. This specially constructed, modern complex lidar is capable of measuring properties of aerosol and optically thin clouds. It is the only one Raman Mie polarization and water vapour lidar in the East-Central Europe. It measures the aerosol profiles on a dozen channels, covering the troposphere and the low stratosphere. After being thoughtfully processed, measurements give quantitative information on the amount of aerosol, size and shape of particles, altitude at which they occurred, and how thick layers they formed. Lidar conducts observations meeting stringent technical requirements of the European Aerosol Research Lidar Network (EARLINET), within the pan-European Aerosol, Clouds and Trace Gases Research Infrastructure (ACTRIS). Both the measurement data, as well as the data products of manual processing carried out by dedicated staff at RS-Lab are characterized by high quality and are considered by many recognized experts as one of the most valuable and reliable source of information within EARLINET.

In our 2-year project, scientific research will be carried out with an aim to provide a full description of the physical and optical properties of mineral dusts observed over Warsaw. Study is based on the vast amount of high-quality data provided by the aforementioned instruments and networks. Statistical approach will be applied for a decade of lidar data. Knowing these properties, the determined type of aerosol will be interpreted using trajectories of air mass transport model (HYSPLIT) and models predicting dust occurrence (NAAPS, NMMB/BSC-Dust). Fraction due to the fine and coarse dust grains as well as mixtures of dust (with e.g. anthropogenic pollution, biomass burning aerosol) to the total aerosol profile will be determined. Designation of these aerosol fractions is crucial to assess aerosol effect on the processes taking place in the atmosphere.

The undeniable advantage of the proposed research is its high potential for future use in climate modeling, radiation processes, as well as in cloud formation studies.